investigators at the beginning of the twentieth century invoked other criteria such as the type of neuron found in an area and the thickness of different layers of cortex to demarcate regions. Although Brodmann lacked any means of linking neural operations with these areas, he clearly hoped that these criteria would differentiate working parts. Subsequently a variety of other indirect criteria, such as topographical mapping, have been used to refine such maps (van Essen & Gallant, 1994). The justification for using such indirect criteria is the assumption that they track features (e.g., morphologically distinct types of neurons) that should matter operationally.

Ultimately, it is the integration of structural decomposition with functional decomposition that provides real answers to the question of which parts are working parts. In subsequent chapters we will encounter a variety of methods employed for structural decomposition of cells and also the advantage attained when cell biologists integrated these results with those from functional decomposition.

Identifying Component Operations

Turning now to functional decomposition, here the strategy is to start with the overall function of the mechanism and figure out what lower-level operations contribute to achieving it. These operations are characterized differently in different sorts of mechanisms. In biochemistry, the typical operation is a chemical reaction catalyzed by an enzyme (active part) that transforms a substrate into a product (the passive parts). The biochemical system that performs glycolysis in cells, for example, catabolizes glucose to pyruvate via a series of such reactions, each of which may oxidize or reduce a substrate, add or remove phosphate groups, etc. Often it is possible to determine, at least to a first approximation, what the internal operations of a mechanism are without knowing what active parts perform these operations (the passive parts do need to be known, though, because the identity of the operation depends upon what is changed). In the case of glycolysis, biochemists were able to determine the chemical reactions that realized this function and to designate a responsible agent (enzyme) for each reaction without knowing the chemical structure of the agents (Bechtel, 1986b). Instead of direct access to the structures operative within the system, such decompositions rely on cleverly designed perturbations of the functioning of the system that provide clues to the component operations. In such cases, then, functional decomposition precedes structural decomposition.

Some experiments designed to identify internal operations involve manipulation and measurement of variables without explicitly going inside the